



THE COUNTY COUNCIL FOR THE COUNTY PALATINE
OF LANCASTER.

TECHNICAL INSTRUCTION COMMITTEE.

REPORT
OF
Experiments on Farm Crops
CONDUCTED AT THE
COUNTY COUNCIL FARM, HUTTON,
AND
AT OTHER CENTRES IN LANCASHIRE
During 1898.

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INTRODUCTION.

In 1898 the following experiments were conducted in Lancashire, either at the County Council Farm or at other Centres throughout the County :—

- I.—On the manuring of Meadow Hay at Twelve Centres.
- II.—On the manuring of Clover Hay at Eight Centres.
- III.—On the manuring of Potatoes at Ten Centres.
- IV.—On the manuring of Swedes at Seven Centres.
- V.—On Finger and Toe Experiments at Two Centres.

In addition to these, the following trials were carried out at the County Council Farm only :—

- 1.—A comparison of the crops yielded by seven varieties of Potatoes.
- 2.—The effects of spraying Potatoes as a preventive of Potato Disease.
- 3.—The action of Lime in causing scab on Potatoes.
- 4.—A comparison of the crop yielded by twenty varieties of Swedes.
- 5.—The effect of spraying Charlock among Oats with a solution of Sulphate of Iron.
- 6.—The inoculation of soil with “ Nitragin ” and “ Alinit ” for the growth of Beans and Oats respectively.

The experiments on the manuring of Clover and Potatoes were made in conjunction with Professor Wright, of the Glasgow Technical College, who conducted similar experiments at a large number of Centres in several counties in Scotland.

OBJECTS OF THE MANURIAL EXPERIMENTS.

The use of artificial manures in Lancashire is trifling compared with the extent to which they are employed in some other counties. Unlike the practice followed in most districts the Swede and Potato crops in Lancashire are grown for the most part with Farmyard Manure alone, artificials not being used. The small amount of arable land in the County, and the large quantity of town manure available, are the reasons assigned for the small amount of artificials

used. During the Winter of 1897-8, the following questions were frequently discussed at the close of my lectures delivered at the various centres :—

1.—Is town manure, taking into consideration the expense of carting and spreading, worth the high price often paid for it?

2.—May artificial manures, now that they have become so reasonable in price, be profitably applied to meadows where dung is not available?

3.—What kinds, quantities, and combinations of artificials will yield the best results for the growth of Meadow and Clover Hay?

4.—Is the addition of artificial manures, along with farmyard manure, to Swedes and Potatoes, a profitable practice?

To answer some of these questions, and at the same time to provide materials as the basis for future discussion, were the chief objects of these manurial trials.

The size of the plots, in nearly every case, was $\frac{1}{20}$ of a statute acre. Owing to the smallness of some of the fields it was found impossible to make these plots any larger without, at the same time, impairing the accuracy of the experiments.

The manures employed were analysed by Mr. A. J. Cooper, B.A., B.Sc., F.I.C., Principal of the Harris Institute, and found to be of normal quality, the potash manure being, in all cases, unless otherwise stated, in the form of the Sulphate or Muriate, with a purity of about 95 per cent.

In studying the tables the results on individual farms should not be considered conclusive; it is much better and safer to take the average of all the farms on which to base general conclusions, because no matter how carefully the experiment may have been carried out the results on any single farm are liable to be influenced by slight inequalities of soil and other variations in conditions; when, for any reason, the results at any centre appeared to me either unreliable, or where the manures were not applied strictly in accordance with the main scheme, they have either not been published or, at least, not included in the averages.

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February 18th, 1899.

EXPERIMENTS ON THE MANURING OF MEADOW HAY.

The primary object of this experiment was to test the value of a few of the common artificial fertilizers for the growth of Meadow Hay.

Farmyard Manure is for the most part the only fertilizer applied to meadow land in Lancashire. Taking into consideration the cost of carting and spreading, it is highly probable that too high a price is often paid for Farmyard Manure, more particularly for inferior sorts.

The Artificial Manures were applied alone, and also on adjoining Plots, with an even dressing of ten tons of Farmyard Manure per acre. As will be seen by reference to the accompanying table, the Farmyard Manure Plots were added at some of the centres only. The Farmyard Manure was applied early in spring, about the same time as the Artificial Manures.

On some of the Farms the produce, when ready, was thoroughly dried, in other cases not completely so.

The plan of manuring was a very simple one. The following are the points on which the experiment throws light.

The comparative results from the application of :—

1.—Equal amounts of Phosphate from Basic Slag and Super (Plots 2 and 3).

2.—Equal amounts of Nitrogen from Sulphate of Ammonia and Nitrate of Soda (Plots 4 and 5).

3.—Equal amounts of Phosphate from Basic Slag and Super, along with Sulphate of Ammonia (Plots 6 and 7).

4.—Equal amounts of Phosphate from Basic Slag and Superphosphate, along with Sulphate of Ammonia and Muriate of Potash (Plots 8 and 9).

5.—Nitrogenous Manure alone, and in combination with Phosphate, and with Phosphate and Potash (Plots 4, 6, 8, and 4, 7, 9).

6.—A mixed Manure in quantities of 3, 5, and 7 cwts. per acre (Plots 10, 11, and 12).

7.—Ten tons Farmyard Manure alone, compared with Artificials alone (Plots 1a compared with Plots 2 to 12).

8.—Ten tons Farmyard Manure alone, compared with ten tons Farmyard Manure along with Artificials (Plots 1a compared with Plots 2a to 12a).

RESULTS.

1.—*Influence of equal amounts of Phosphate from Slag and Super (Plots 2 and 3).*

The figures obtained from these two Plots are :—

	Average increase over Unmanured Plots.	
	cwts. qrs.	
3 cwts. Basic Slag	0	3
322 lbs. Super	1	0

These two Plots alone of all those dressed with Artificial Manure did not yield a profitable return.

2.—*Influence of an equal amounts of Nitrogen from Sulphate of Ammonia and Nitrate of Soda (Plots 4 and 5).*

The figures in this case are :—

	Average increase over Unmanured Plots.	
	cwts. qrs.	
1 cwt. Sulphate of Ammonia	10	0
141 lbs. Nitrate of Soda	12	3

Both these manures have yielded a profitable increase, but Nitrate of Soda has yielded the better return. It must, however, be remembered that these figures represent the first cut only, and it is very generally believed that the application of nitrogenous manures alone, while they yield a profitable return in the first year, do not leave the land in good condition for future crops. The estimated profit per acre, after deducting the cost of the manure (if 2s. 6d. is not considered too high a price for one cwt. of hay) is 21s. 9d. from the Nitrate of Soda, and 15s. from the Sulphate of Ammonia.

3.—*Influence of equal amounts of Phosphate from Slag and Super, along with Sulphate of Ammonia (Plots 6 and 7).*

The following figures afford a comparison of the results obtained from these Plots :—

	Average increase over Unmanured Plots.	
	cwts. qrs.	
3 cwts. Basic Slag	12	0
322 lbs. Superphosphate	11	2

These dressings have also yielded profitable returns, the estimated profit being 14s. per acre from the use of Slag and Sulphate of Ammonia, and 11s. 6d. from the use of Super and Ammonia.

4.—*Comparative yield from (1) Basic Slag and (2) Superphosphate, in combination with Sulphate of Ammonia and Muriate of Potash (Plots 8 and 9).*

The figures in this case are :—

	Average increase over Unmanured Plots. cwts. qrs.	
3 cwt. Basic Slag	11	1
322 lbs. Super	14	0

The estimated profit per acre from these two applications is 6s. 3d. in the case of Super, while the crop from Slag has just been sufficient to cover the cost of the Manure. There is a considerable increase in the crop, but the expensive nature of the Manure has diminished the profits.

5.—*Comparison of the results from (1) Nitrogenous Manures alone, (2) Nitrogenous Manures with Phosphate, and (3) Nitrogenous Manures in combination with Phosphate and Potash (Plots 4, 6, 8, and 4, 7, 9).*

In this case there are two series of Plots to be compared, viz. : the series in which the Phosphate is derived from Basic Slag, and that in which the Phosphate is derived from Superphosphate. The following table shows the results :—

Phosphate from Basic Slag :—

	Average increase over Unmanured Plots. cwts. qrs.		Estimated Profit per acre. s. d.	
1 cwt. Sulphate of Ammonia . . .	10	0	15	0
1 cwt. Sulphate of Ammonia } 3 cwts. Basic Slag }	12	0	14	0
1 cwt. Sulphate of Ammonia } 3 cwts. Basic Slag }	11	1	0	7
1 cwt. Muriate of Potash }				

Phosphate from Superphosphate :—

	Average increase over Unmanured Plots. cwts. qrs.		Estimated Profit per acre. s. d.	
1 cwt. Sulphate of Ammonia . . .	10	0	15	0
1 cwt. Sulphate of Ammonia } 322 lbs. Super }	11	2	11	6
1 cwt. Sulphate of Ammonia } 322 lbs. Super }	14	0	6	3
1 cwt. Muriate of Potash }				

The application of Potash along with Basic Slag has not increased the crop. On the other hand there is an increase where Potash was used along with Super. On comparing the estimated profit in each case it will be seen that the largest return has been obtained from the use of Sulphate of Ammonia alone; in each series the addition of Phosphate or of Phosphate and Potash has very considerably reduced the money return. It must be remembered, however, that in the case where a triple fertilizer is employed, there is less danger of the land being exhausted than where Sulphate of Ammonia is employed by itself. The hay crop does remove considerable quantities of both Phosphates and Potash, as well as Nitrogen, and if these be not returned the resources of the soil are materially diminished. In the majority of cases it has been found that the application of a complete manure, that is, one containing Nitrogen, Phosphate, and Potash, has yielded not only larger, but, in most cases, more profitable returns than the application of a manure containing one of these substances alone, or even a mixture of two of them. The application of one cwt. of Muriate of Potash adds considerably to the cost, and, as it has not materially increased the yield, the profit is thereby very seriously diminished. It is highly probable that the non-effect of Potash to the meadow crops in Lancashire is due to the fact that the land has been in previous years, repeatedly, and at short intervals, covered with Farmyard Manure, a substance that is not exhausted in one season, and it is well known that in the residue from Farmyard Manure there is a considerable amount of Potash. It must therefore be concluded that the application of 1 cwt. concentrated Muriate of Potash, along with Nitrogen and Phosphates, to the meadow land in Lancashire, is not a practice to be generally recommended.

6.—*Comparison of the results from mixed manures in quantities of 3, 5, and 7 cwts. per acre (Plots 10, 11, and 12).*

To Plots 10, 11, and 12 there was applied 3, 5, and 7 cwts. respectively of a mixture composed of two parts Superphosphate, one part Sulphate of Ammonia, and half-part of Muriate of Potash. This mixture is one, which, on average land, may be safely recommended. It may not yield a money return equal to that obtained from an application of a heavy dressing of nitrogenous manures alone, but it is a safe mixture, and, like Farmyard Manure, supplies, not one or two, but all three substances which are specially required by crops. It was assumed that such a mixture would yield the most profitable return, and the object of varying the quantity was to illustrate an important principle, viz., liberal manuring is profitable,

even though the fertilizers be added in excess of the requirements of the crop. In this mixture the percentage of potash is less than in Plots 8 and 9, and in consequence we find the cost per acre is reduced, and the estimated profit is much greater. The following figures afford a comparison of the crops from these three Plots:—

	Average Increase over Unmanured Plot.			Estimated Profit per Acre.	
	cwts. qrs.			s.	d.
3 cwts. mixed Manure ...	11	1	...	10	4
5 ,, ,, ...	17	2	...	14	1
7 ,, ,, ...	22	0	...	13	6

The medium dressing, though it has not given the largest crop, has yielded, by reason of its smaller cost, the highest money return.

7.—*Ten tons Farmyard Manure alone compared with Artificials alone (Plots 1a and Plots 2 to 12 inclusive).*

Ten tons Farmyard Manure applied to the Hay crop has yielded an increase of 9 cwts. 1 qr. over the unmanured Plots. Plots 4 to 12 inclusive, to which artificials alone were applied, yield in every instance a larger return.

This result is very important, inasmuch as there is meadow land in Lancashire to which Artificial Manures are rarely or never applied, and which is not dunged oftener than once in two or three years, on account of the scarcity or high price of dung. This experiment forcibly demonstrates that even in the first cut Artificial Manures yield not only a large but a highly profitable increase, and, when properly compounded, form a reliable substitute for dung.

8.—*Comparison of the results from the use of Artificials along with Farmyard Manure (compare Plots 1a with Plots 2a to 12a inclusive).*

On comparing the results from the Artificials alone, with those from Artificials in combination with Farmyard Manure, it is evident that the latter practice is not so generally profitable as the use of Artificials and Farmyard Manure separately. Plots 4a, 5a, and 6a have yielded profitable returns, but the remaining Plots are characterized by loss, or at most, small gains. The increase due to Artificials in combination with dung is, in almost every case, much smaller than that obtained from the use of Artificial Manures alone. The inference from this is quite clear, viz., Farmyard Manure does not require the addition of Artificials for the growth of profitable crops of Meadow Hay.

This experiment ought to be followed up by others to show whether the system of applying Farmyard Manure and Artificials in alternate years is attended with profitable results. Such a scheme is now in contemplation, and that the system will be attended with good results may be confidently anticipated.

SUMMARY OF RESULTS.

I.—Phosphatic Manures alone are not profitable as a top dressing for Meadow Hay.

II.—Sulphate of Ammonia or Nitrate of Soda yield in the first cut large and profitable returns.

III.—The addition of one cwt. 95 per cent. Muriate of Potash, per acre, along with Phosphates and Ammonia, is not so profitable for the Hay Crop in Lancashire, as is the case where Farmyard Manure is less generally employed.

IV.—A dressing for Meadow Hay that may be safely relied on to yield a profitable return, and, at the same time, is not likely to exhaust the land, consists of 5 cwts. per acre of a mixture of two parts Superphosphate, one part Sulphate of Ammonia, and *half*-part Muriate of Potash.

V.—Ten tons Farmyard Manure has yielded a smaller crop than the Artificials applied to Plots 4 to 12 inclusive.

VI.—The application of Artificial Manures, along with Farmyard Manure, has not generally been attended with profitable results.

VII.—The whole Experiment indicates that when Farmyard Manure is not available, the use of a skilfully compounded mixture of Artificials will, for at least one season, yield a large and profitable crop.

Experiments on the Manuring of Meadow Hay, 1898.

TABLE shewing the Kinds and Quantities of Manure applied, together with the Weight of First Cut, the Value of the Increase due to Artificial Manures, the Cost of the Manures, and the Estimated Profit or Loss from the different applications, all calculated per statute acre.

Without Farmyard Manure.																With an even dressing of Ten Tons Farmyard Manure per Acre.												
DISTRICT.	NAME OF FARM.	NAME OF EXPERIMENTER.	AGE AND NATURE OF GRASS.	1	2	3	4	5	6	7	8	9	10	11	12	1a	2a	3a	4a	5a	6a	7a	8a	9a	10a	11a	12a	
				No Artificial Manure. Average of Two Un-manured Plots.	3 cwt. Basic Slag.	‡322 lbs. Super-phosphate.	‡1 cwt. Sulphate of Ammonia	‡141 lbs. Nitrate of Soda.	3 cwt. Basic Slag 1 cwt. Sulphate of Ammonia.	‡322 lbs. Super-phosphate 1 cwt. Sulphate of Ammonia.	3 cwt. Basic Slag 1 cwt. Sulphate of Ammonia 1 cwt. Muriate of Potash.	322 lbs. Super-phosphate 1 cwt. Sulphate of Ammonia 1 cwt. Muriate of Potash.	3 cwt. of Mixed Manure.†	5 cwt. Mixed Manure.†	7 cwt. Mixed Manure.†	10 tons Farmyard Manure average of two plots.	3 cwt. Basic Slag.	322 lbs. Super-phosphate.	1 cwt. Sulphate of Ammonia	141 lbs. Nitrate of Soda.	3 cwt. Basic Slag 1 cwt. Sulphate of Ammonia.	322 lbs. Super-phosphate 1 cwt. Sulphate of Ammonia.	3 cwt. Basic Slag 1 cwt. Sulphate of Ammonia 1 cwt. Muriate of Potash.	322 lbs. Super-phosphate 1 cwt. Sulphate of Ammonia 1 cwt. Muriate of Potash.	3 cwt. of Mixed Manure.	5 cwt. Mixed Manure.	7 cwt. Mixed Manure.	
I.—Abbeystead ...	Abbeystead	Mr. Whitaker.....	Old meadow	20 2	21 1	25 0	22 2	24 1	23 2	21 2	25 2	35 2	26 1	34 1	43 2	36 3	36 3	38 2	41 0	40 0	42 1	41 1	42 3	41 1	39 1	44 3	47 2	I.
II.—Bolton	Cross Lane	Mr. Bell	{ Old meadow — full of weeds. }	44 0	41 3	41 2	49 3	48 2	45 1	40 1	44 3	36 0	48 2	54 2	59 3	62 1	55 1	56 1	57 3	60 2	62 3	60 2	61 2	56 0	58 2	68 1	67 2	II.
III.—Bolton	Hodgkinson's	Mr. Holgate..	Fine grasses.....	22 0	24 3	28 1	34 3	34 3	39 0	32 0	36 1	38 0	35 1	40 1	39 1	36 2	37 1	39 2	47 2	54 0	52 1	45 0	47 1	42 3	44 0	45 3	45 1	III.
IV.—Bolton	Ainsworth Hall	Mr. Ormerod	Large grasses chiefly.....	30 0	25 3	32 2	40 3	53 3	26 1	45 0	31 2	42 2	41 1	50 0	53 1	55 0	48 2	46 2	47 3	58 1	60 3	56 0	75 3	59 0	55 0	59 0	61 3	IV.
V.—Brindle	Marsden Fold	Mr. C. Webster	Fine grasses.....	29 3	31 0	31 2	44 0	50 0	47 2	43 0	46 2	45 3	39 0	47 1	52 3	59 1	59 0	61 3	70 2	71 0	67 0	65 1	64 1	68 2	62 0	72 2	68 2	V.
VI.—Garstang	Brooks barn	Mr. A. King	Old meadow.....	51 0	41 2	60 3	64 3	67 1	57 3	68 3	71 3	88 3	76 3	62 1	73 0	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	VI.
VII.—Lowton.....	Lowton Hall	Mr. T. Marsh	{ Old meadow — fine grasses. }	34 3	36 0	35 3	44 1	.....	47 3	50 1	49 3	55 0	51 0	54 1	57 2	25 3	41 2	37 3	43 1	.....	49 1	49 2	48 1	46 2	45 3	50 1	52 2	VII.
VIII.—Poulton	Lowercross	Mr. W. G. Bennett...	Old meadow.....	64 1	66 3	70 1	83 1	69 2	83 1	72 3	73 2	81 3	73 2	78 0	82 1	79 0	82 0	86 1	90 3	81 3	90 1	87 3	89 3	90 0	87 0	85 3	93 0	VIII.
IX.—Poulton	Norcross	Mr. Nelson.....	Old meadow.....	62 0	51 0	57 0	74 3	75 3	78 1	85 1	90 2	89 1	89 0	91 0	92 3	.....	.....*	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	IX.
X.—Poulton	Oldfield Carr	Mr. W. Rossall	Old meadow.....	61 0	71 2	49 2	64 0	58 0	63 0	61 1	61 2	66 0	62 2	62 3	71 3	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	.....	X.
XI.—Standish	Giant's Hall	Mr. R. Gill	Second year grass	29 2	35 3	33 1	42 0	55 3	49 0	47 1	38 1	42 3	46 2	52 2	57 1	25 3	38 2	38 2	52 2	57 1	49 2	48 2	44 3	44 0	48 1	53 2	58 0	XI.
XII.—Hutton	County Council Farm	Tech. Ins. Committee	{ Mixed grasses — large and small. }	43 2	44 0	40 0	48 2	51 3	61 0	62 3	66 0	62 0	62 0	66 0	70 0	60 0	62 0	59 0	61 0	63 1	61 0	61 2	69 3	64 0	63 2	74 3	84 0	XII.
XIII.—Hutton	County Council Farm	Tech. Ins. Committee	{ Old meadow — fine-leaved herbage }	34 2	35 2	44 0	49 3	55 3	56 3	53 2	48 1	50 0	37 2	.....	.....	49 3	54 2	51 0	60 0	58 0	58 1	56 2	57 3	57 2	41 2	.....	.....	XIII.
TOTAL				475 3	485 0	488 2	598 1	577 0	620 3	614 3	612 1	644 2	612 1	630 3	680 0	490 0	515 1	515 0	572 0	544 0	593 1	571 3	601 3	569 2	544 3	554 2	578 0	
Average				39 3	40 2	40 3	49 3	52 2	51 3	51 1	51 0	53 3	51 0	57 1	61 3	49 0	51 2	51 2	57 1	60 2	59 1	57 1	60 1	57 0	54 2	61 2	64 1	
A.—Increase over Plots receiving no Artificials (Columns 1 and 1a respectively) .....				.....	3	1 0	10 0	12 3	12 0	11 2	11 1	14 0	11 1	17 2	22 0	.....	2 2	2 2	8 1	11 2	10 1	8 1	11 0	8 0	5 2	12 2	15 1	A
B.—Value of Increase per acre, at 2/6 per cwt. ....				.....	1/10	2/6	25/-	31/10	30/-	28/9	28/1	35/-	28/1	43/9	55/-	.....	6/3	6/3	20/7	28/9	25/7	20/7	28/1	20/-	13/9	31/3	38/1	B
C.—Cost of Artificial Manures per acre .....				.....	6/-	7/3	10/-	10/1	16/-	17/3	27/6	28/9	17/9	29/8	41/6	.....	6/-	7/3	10/-	10/1	16/-	17/3	27/6	28/9	17/9	29/8	41/6	C
D.—Estimated Profit * or Loss † per acre due to Artificial Manure .....				.....	†4/2	†4/9	*15/-	*21/9	*14/-	*11/6	*-/7	*6/3	*10/4	*14/1	*13/6	.....	*-/3	†1/-	*10/7	*18/8	*9/7	*3/4	*-/7	†8/9	†4/-	*1/7	†3/5	D

† Composition of Mixed Manure ... { Superphosphate, 2 parts by weight. Sulphate of Ammonia, 1 part by weight. Muriate of Potash, ½ part by weight.

‡ Containing Phosphoric Acid equal to that applied to Plots 2, 6, and 8.

§ Containing Nitrogen equal to that applied to Plots 4, 6, and 8.

* This line is not included in averages. The same kinds but not the same quantities of manure were used

EXPERIMENTS ON THE MANURING OF CLOVER HAY.

This Experiment was conducted at eight Centres in Lancashire, and in conjunction with Professor Wright, of the Technical College, Glasgow, at 19 Centres, comprising 8 Counties, in the south-west and centre of Scotland. Plot 5 was not, however, included in the Scottish experiments. Bone Flour is largely employed in Lancashire as a top dressing for Clover, and on this account Plot 5 was added.

The accompanying table shows the kinds and quantities of manures applied, the average of the results obtained from the eight Centres in Lancashire the cost of the manures and estimated profit per acre.

RESULTS.

I.—*Comparative effect of equal amounts of Nitrogen from Sulphate of Ammonia and Nitrate of Soda (Plots 2 and 3).*

On the average these two Plots have yielded an increase of $9\frac{1}{2}$ and $9\frac{3}{4}$ cwts. respectively over the unmanured Plot. As the cost of the manures applied to Plots 2 and 3 is the same, no advantage, so far as this experiment shows, can be claimed for one over the other when used alone.

When these manures were applied along with Muriate of Potash and Basic Slag (Plots 8 and 9), the Nitrate of Soda yielded the largest return, and the same was the case when the manures were applied along with 10 tons Farmyard Manure (Plots 11 and 12). The following are the figures comparing the average increase over the unmanured Plots from the use of equal amounts of Nitrogen, from Nitrate of Soda and Sulphate of Ammonia :—

	Alone.		With 2 cwts. Basic Slag and 2 cwts. Muriate of Potash.		With 10 tons Farmyard Manure.
	cwts. qrs.		cwts. qrs.		cwts. qrs.
1 cwt. Nitrate of Soda.....	9 3	...	21 3	...	30 0
88 lbs. Sulphate of Ammonia...	9 2	...	18 0	...	25 3
Difference in favour of Nitrate of Soda	0 1	...	3 3	...	4 1

II.—*Comparative effect of equal amounts of Phosphoric Acid from Basic Slag and Bone Flour (Plots 4 and 5).*

On the average the results are identical, namely :—an increase of $8\frac{1}{4}$ cwts. over the unmanured land. The Bone Flour applied to Plot 5 cost slightly more than the Basic Slag applied to Plot 4.

III.—*Comparative effect of a mixture of 2 cwts. Basic Slag and 1 cwt. Nitrate of Soda, along with $\frac{1}{2}$ cwt., 1 cwt., and 2 cwts. Muriate of Potash respectively (Plots 6, 7, and 8).*

The mixture applied to Plot 8 has, in previous experiments, yielded excellent results, not only in the first cut, but also in the second ; but two cwts. Muriate of Potash adds about 23s. to the cost per acre. The object of this part of the experiment is obvious. It is to discover whether equally good results can be got by the application of less than two cwts. Muriate of Potash, along with Basic Slag and Nitrate of Soda.

The following are the figures :—

						Average Increase over Unmanured Land.	
1 cwt. Nitrate of Soda and 2 cwts. Basic Slag, with—							
Plot 6	...	$\frac{1}{2}$ cwt. Muriate of Potash	...	...	...	18	0
„ 7	...	1 „ „ „	...	...	...	22	1
„ 8	...	2 „ „ „	...	...	...	21	3

On the average 1 cwt. Muriate of Potash has yielded even a better result than 2 cwts. The application of $\frac{1}{2}$ cwt. is clearly insufficient for the requirements of the crop. The result is a very important one, and the effect is seen in the estimated profit per acre, Plot 7 yielding the best money return, not being burdened, like Plot 8, with the cost of an expensive manure. On this point it will be extremely interesting to compare the Lancashire results with those of the Scottish experiments.

IV.—*Comparative effect of 10 tons Farmyard Manure alone and in combination with 1 cwt. Nitrate of Soda (Plots 10 and 11).*

The application of Nitrate of Soda, along with Farmyard Manure, is a practice that has been discredited. In this case, however, 1 cwt. Nitrate of Soda lost none of its effect by being combined with 10 tons Farmyard Manure. Alone (Plot 3) 1 cwt. Nitrate of Soda increased the crop $9\frac{3}{4}$ cwts. over the unmanured land. With 10 tons Farmyard Manure 1 cwt. Nitrate produced an equal increase of crop over the yield from 10 tons Farmyard Manure alone, namely $9\frac{3}{4}$ cwts.

V.—*The most Profitable Application.*

Owing to the latter part of the season being very dry there was no second cut, and consequently the question of the most profitable application can scarcely be answered. So far, however, as the first cut is concerned Plot 7 has yielded the most profitable result. The mixture employed on that Plot is one which may safely be recommended as a top dressing for a mixture of Clover and Ryegrass. It forms a complete manure, and is, therefore, well calculated to take the place of Farmyard Manure when that cannot be obtained.

SUMMARY OF RESULTS.

1.—The application of manure, either in the form of Farmyard Manure or of Artificials, has yielded a profitable return.

2.—Nitrate of Soda alone yielded no better results than Sulphate of Ammonia, but used along with Farmyard Manure, or with a mixture of Basic Slag and Muriate of Potash, it yielded better results than Sulphate of Ammonia used under the same conditions.

3.—One cwt. Muriate of Potash, along with Nitrate of Soda and Basic Slag, yielded better and more profitable results than either $\frac{1}{2}$ cwt. or 2 cwts. Muriate with the same quantities of Basic Slag and Nitrate of Soda.

4.—Nitrate of Soda, along with Farmyard Manure, yielded an increase equal to that where it was used alone.

5.—For Clover Hay the mixture of Artificials recommended from among those used in this experiment is the following, stated in cwts. per acre:—

2 cwts. Basic Slag.
1 cwt. Muriate of Potash.
1 cwt. Nitrate of Soda.

Experiments on Manuring of Clover Hay, 1898.

TABLE showing the Kinds and Quantities of Manure applied, together with the Weight of First Cut, the Value of the increase due to the Manures, the Cost of the Manures, and the Estimated Profit or Loss from the different applications, all calculated per statute acre.

DISTRICT.	NAME OF FARM.	NAME OF EXPERIMENTER.	NATURE AND CONDITION OF SOIL.	1	2	3	4	5	6	7	8	9	10	11	12
				Average of Two Un-manured Plots.	88 lbs.† Sulphate of Ammonia.	1 cwt. Nitrate of Soda.	6 cwt. Basic Slag.	394 lbs. Bone Flour.	½-cwt. Muriate of Potash, 2 cwt. Basic Slag, 1 cwt. Nitrate of Soda.	1 cwt. Muriate of Potash, 2 cwt. Basic Slag, 1 cwt. Nitrate of Soda.	2 cwt. Muriate of Potash, 2 cwt. Basic Slag, 1 cwt. Nitrate of Soda.	2 cwt. Muriate of Potash, 2 cwt. Basic Slag, 88 lbs. Sulphate of Ammonia.	10 tons Farmyard Manure.	10 tons Farmyard Manure, 1 cwt. Nitrate of Soda.	10 tons Farmyard Manure, 88 lbs. Sulphate of Ammonia.
				Cwt qrs	Cwt qrs	Cwt qrs	Cwt qrs	Cwt qrs	Cwt qrs	Cwt qrs	Cwt qrs	Cwt qrs	Cwt qrs	Cwt qrs	Cwt qrs
Yealand Conyers..	The Dykes	Mr. Escolme	Gravelly	37 3	51 0	55 3	42 1	45 0	70 1	71 2	92 1	61 2	66 3	80 2	77 1
Kirkham	Wrea Green	Mr. Hale	Strong soil	† 55 0	65 0	65 0	65 0	62 2	65 0	72 2	70 0	63 0	73 2	*	*
Hutton	County Council Farm	Tech. Ins. Committee	Dark loam	† 47 1	*	53 0	56 2	50 3	59 0	62 1	61 2	58 2	62 1	66 3	63 2
Garstang	Needless Farm	Mr. Porter	Black peaty loam	51 3	71 2	64 1	78 0	75 0	74 3	75 1	78 3	81 0	79 2	98 2	99 3
Newton-le-Willows	Lowton	Mr. J. Bent	Loamy soil (medium)	47 2	62 0	58 3	48 2	52 1	73 1	74 3	66 0	67 1	70 0	100 0	78 3
Poulton	Shard Bridge	Mr. Baxter	Mixed loam	44 3	43 1	44 2	51 1	50 1	57 1	65 2	63 3	63 2	62 2	67 1	76 0
Poulton	Old Field Carr.....	Mr. Rossall	Loose soil on blue clay	53 0	52 3	58 2	56 3	62 1	70 0	77 1	64 0	68 0	66 2	63 0	55 2
Wigan	Giant's Hall.....	Mr. Gill	Medium loam	44 1	55 1	59 3	50 0	50 1	58 1	60 2	60 1	63 2	62 1	68 3	64 0
TOTAL				381 1	400 3	459 2	448 1	448 1	527 3	559 2	556 2	526 1	543 1	544 3	514 3
Average				47 3	57 1	57 2	56 0	56 0	65 3	70 0	69 2	65 3	68 0	77 3	73 2
Increase over Unmanured Plot ...				...	9 2	9 3	8 1	8 1	18 0	22 1	21 3	18 0	20 1	30 0	25 3
Value of Increase @ 2/6 per cwt...				...	23/9	24/4	20/7	20/7	45/-	55/8	54/4	45/-	50/7	75/-	64/4
Cost of Manures per acre				...	8/-	8/-	12/-	13/3	17/9	23/6	35/-	36/-	40/-	48/-	48/-
Estimated Profit per acre.....				...	15/9	16/4	8/7	7/4	27/3	32/2	19/4	9/-	10/7	27/-	16/4

* These Plots not being uniformly treated with the rest of the Experiment are not included in the averages.

† At these stations there was only one Plot Unmanured.

‡ Containing Nitrogen equal to that applied to Plot 3.

EXPERIMENT ON THE MANURING OF POTATOES.

This experiment was also conducted in conjunction with Professor Wright, of Glasgow.

In Lancashire there were ten Centres, and in Scotland 19, distributed over 8 Counties. At one Centre in Lancashire, viz.: Brooksbarn, Garstang, the experiment was carried out on somewhat different lines from the rest of the experiments, the Artificial Manures being applied alone, and not in conjunction with Farmyard Manure. The results at Brooksbarn have a special interest, and they will be dealt with in a separate table.

The following shows the system of manuring adopted, and also the average of the total weight of Potatoes obtained per acre :—

No. of Plot.	Kinds and quantities (per acre) of Manures applied.		Average yield per Acre (8 Farms).		
			tons.	cwts.	qrs.
1	No Manure		5	7	2
2	20 tons Farmyard Manure		9	15	1
3	10 „ „		8	19	3
4	10 tons Farmyard Manure along with	1 cwt. Sulphate of Potash	9	14	0
5		4 cwts. Superphosphate	9	11	3
6		*141 lbs. Nitrate of Soda	8	19	2
7		1 cwt. Sulphate of Ammonia	9	11	0
8		{ 4 cwts. Superphosphate 1 cwt. Sulphate of Ammonia }	9	11	3
9		{ 4 cwts. Superphosphate *141 lbs. Nitrate of Soda }	9	7	2
10		{ 1 cwt. Sulphate of Ammonia 1 cwt. Sulphate of Potash }	9	6	1
11		{ *141 lbs. Nitrate of Soda 1 cwt. Sulphate of Potash }	9	2	3
12		{ 4 cwts. Superphosphate 1 cwt. Sulphate of Ammonia 1 cwt. Sulphate of Potash }	9	12	2
13		{ 4 cwts. Superphosphate *141 lbs. Nitrate of Soda 1 cwt. Sulphate of Potash }	9	16	3

* Containing the same amount of Nitrogen as 1 cwt. Sulphate of Ammonia (Plot 7).

In the accompanying table will be found the names of those who undertook the experiment in Lancashire, the variety of Potatoes used, the yield at each Centre, the cost of manures, and estimated profit per acre.

RESULTS.

I.—Comparative effect of a heavy and medium dressing of Farmyard Manure alone (Plots 2 and 3).

Ten tons of Farmyard Manure per acre is a medium dressing. Careful spreading is necessary in order to get such a quantity to “meet” in the rows; 20 tons, on the other hand, must be regarded as a liberal dressing, and, with such, there is no difficulty in getting the bottom of each row well covered with the manure. The average results from these manures are :—

				Increase over Unmanured Plot.		
				tons.	cwts.	qrs.
20 tons Farmyard Manure	...	...	..	4	7	3
10 tons Farmyard Manure	...	...	...	3	12	1
Difference in favour of double dressing ...				15		2

It is quite evident that the value of 15½ cwts. of Potatoes is not commensurate with the cost of the double dressing of Farmyard Manure.

II.—The effect of applying (a) 1 cwt. of 95 per cent. Sulphate of Potash (b) 4 cwts. Superphosphate (c) 141 lbs. Nitrate of Soda, and (d) 1 cwt. Sulphate of Ammonia, each along with 10 tons Farmyard Manure (Plots 4, 5, 6, and 7).

The following are the figures :—

				Difference (Increase or Decrease) from the yield due to 10 tons Farmyard Manure alone.		
				cwts. qrs.		
1 cwt. (95 %)	Sulphate of Potash	...	...	14	1	Increase
4 cwts.	Superphosphate...	...	...	12	0	Increase
141 lbs.	Nitrate of Soda	...	...		1	Decrease
1 cwt.	Sulphate of Ammonia	...	...	11	1	Increase

The application of Nitrate of Soda along with 10 tons Farmyard Manure has not increased the crop if we regard merely the average of the results. Superphosphate, Sulphate of Potash, and Sulphate of Ammonia have each yielded a profitable increase, but, from the study of the results on individual farms, this experiment indicates that of these three manures Superphosphate and Sulphate of Potash alone may be most profitably applied to the Potato crop, along with 10 tons Farmyard Manure.

III.—*The effect of applying, along with 10 tons Farmyard Manure, an equal amount of Nitrogen from Sulphate of Ammonia and from Nitrate of Soda ;*

- (a) *With 4 cwts. Superphosphate (Plots 8 and 9) ;*
- (b) *In combination with Sulphate of Potash (Plots 10 and 11) ; and*
- (c) *In combination with Superphosphate and Sulphate of Potash (Plots 12 and 13).*

The following are the figures :—

Comparison of the Average Increase over Plot 3, due to Sulphate of Ammonia and Nitrate of Soda respectively, when applied along with—									
A			B			C			
10 tons Farm- yard Manure, and 4 cwts. Super.			10 tons Farm- yard Manure, and 1 cwt. Sulphate of Potash.			10 tons Farm- yard Manure, 4 cwts. Super, and 1 cwt. Sulphate of Potash.			
cwts. qrs.			cwts. qrs.			cwts. qrs.			
Sulphate of Ammonia ..	12	0	...	6	2	...	12	3	
Nitrate of Soda	7	3	...	3	0	...	17	0	

When Sulphate of Ammonia and Nitrate of Soda were added along with Farmyard Manure, and a mixture of Super and Sulphate of Potash, the returns from the use of Nitrate of Soda exceeded those from Sulphate of Ammonia. Used in the other two combinations Sulphate of Ammonia yielded better results than Nitrate of Soda.

By carefully comparing the figures at the different Centres, it will be seen that the result from combination C is largely due to the return from one farm—The Island, Garstang—where the soil was a pure peat, and where Plot 13 yielded 2 tons, 15½ cwts. increase over Plot 12. On this farm Nitrate of Soda also yielded better results than Sulphate of Ammonia when these manures were applied along with Sulphate of Potash and Farmyard Manure (compare Plots 10 and 11, The Island).

IV.—*The result of applying Artificials along with Farmyard Manure.*

The increase due to the various Artificials is shown in the bottom line of the table. In one case the average result shows a slight decrease, viz., from the application of Nitrate of Soda. In all other cases there is an increase, due to the application of Artificials, but only in four cases can their use be said to have paid. These are the applications used on Plots 4, 5, 7, 8, and 13. The estimated money return per acre on these Plots is shown by the following figures :—

Plot.		Increase over 10 tons Farmyard Manure.	Value of the Increase.			Cost of Artificial Manure.			Estimated Profit per Acre.		
		cwts. qrs.	£	s.	d.	£	s.	d.	£	s.	d.
4	1 cwt. Sulphate of Potash	14 1	1	13	1	0	10	8	1	2	5
5	4 cwts. Superphosphate	12 0	1	10	0	0	10	0	1	0	0
7	1 cwt. Sulphate of Ammonia ...	11 1	1	8	1	0	10	0	0	18	1
8	{ 4 cwts. Super	12 0	1	10	0	1	0	0	0	10	0
	{ 1 cwt. Sulphate of Ammonia }										
13	{ 4 cwts. Super	17 0	2	2	6	1	10	8	0	11	10
	{ 141 lbs. Nitrate of Soda ...										
	{ 1 cwt. Sulphate of Potash .. }										

EXPERIMENT AT BROOKSBARN.

As already stated, the experiment, conducted by Mr. A. King, at Brooksbarn, differed in two important points from those made at other Centres. The experiment was one in which the Artificial Manures on Plots 4 to 14 were tested alone, no Farmyard Manure being employed; but, on the other hand, the Artificials were applied at double the rate. The following Table shows the results:—

No. of Plot.	Kinds and Quantities of Manures per Acre.	Yield per Acre.		TOTAL.
		Saleable.	Small.	
		T. C. Q.	T. C. Q.	T. C. Q.
4	2 cwts. Sulphate of Potash ...	5 7 1	0 19 3	6 7 0
5	8 cwts. Superphosphate	3 14 3	1 7 3	5 2 2
6	*282 lbs. Nitrate of Soda	3 16 2	0 16 2	4 13 0
7	2 cwts. Sulphate of Ammonia	2 13 2	1 3 2	3 17 0
8	{ 8 cwts. Superphosphate	4 10 0	1 3 1	5 13 1
	{ 2 cwts. Sulphate of Ammonia }			

No. of Plan.	Kinds and Quantities of Manures per Acre.	Yield per Acre.		TOTAL.
		Saleable.	Small.	
		T. C. Q.	T. C. Q.	T. C. Q.
9	{ 8 cwts. Superphosphate } { *282 lbs. Nitrate of Soda ... }	6 8 1	1 0 1	7 8 2
10	{ 2 cwts. Sulphate of Ammonia } { 2 cwts. Sulphate of Potash .. }	5 15 0	0 11 2	6 6 2
11	{ *282 lbs. Nitrate of Soda ... } { 2 cwts. Sulphate of Potash .. }	7 3 2	0 16 3	8 0 1
12	{ 8 cwts. Superphosphate } { 2 cwts. Sulphate of Ammonia } { 2 cwts. Sulphate of Potash .. }	8 5 3	0 4 3	8 10 2
13	{ 8 cwts. Superphosphate } { *282 lbs. Nitrate of Soda ... } { 2 cwts. Sulphate of Potash .. }	8 7 2	0 14 0	9 1 2
14	No Manure	3 17 0	0 15 3	4 12 3

* Contains the same amount of Nitrogen as 2 cwts. Sulphate of Ammonia.

The results of the Brooksbarn experiment demonstrate the superiority of a complete manure over an imperfect one. A complete manure must contain Nitrogen, a Phosphate, and Potash. In the experiment each of these was tried alone (Plots 4 to 7), and yielded a crop little better than did the unmanured Plot. Nitrogen, Phosphate, and Potash were also tested in pairs (Plots 8 to 11), with a result of about double the crop obtained when each was used alone. When, however, all the three fertilizers were applied together (Plots 12 and 13), the resulting crop was increased to as much as $8\frac{1}{2}$ tons per acre.

The importance of Potash for the Potato crop is well illustrated by a comparison of Plots 8 and 12. The following are the figures:—

		Yield per Acre. tons. cwts. qrs.		
Plot 8	{ 8 cwts. Superphosphate ... } { 2 cwts. Sulphate of Ammonia ... }	5	13	1
Plot 12	{ 8 cwts. Superphosphate ... } { 2 cwts. Sulphate of Ammonia ... } { 2 cwts. Sulphate of Potash ... }	8	10	2
Increase due to Potash		...	...	2 17 1

This result is one which has been confirmed by many other experiments, and must now be considered to have been established as a fundamental principle, and one which should be taken to heart by all Potato growers. The advantage of Potash to the Potato crop is also apparent on comparing the yield of Plot 4 with that of Plots 5, 6, and 7, as well as with the yield from Plots 9 and 13.

A striking result of the Brooks barn experiment is the excellent return obtained by the Artificial Manures alone, a result which is in striking contrast to the comparatively small increase from these same manures when applied along with Farmyard Manure.

SUMMARY OF RESULTS.

1.—The increase from a double dressing of Farmyard Manure is not commensurate with the extra cost.

2.—The application of Potash along with the Farmyard Manure has been more profitable than any other Artificial Manure or combination of Artificial Manures used under similar conditions.

3.—Nitrate of Soda along with Farmyard Manure resulted in no increase in the yield.

4.—The application of Artificials along with Farmyard Manure yielded small returns compared with those from the use of Artificials alone.

5.—The necessity of using Potash as an ingredient of an Artificial Manure for Potatoes, has been forcibly demonstrated.

Experiments on the Manuring of Potatoes, 1898.

TABLE shewing the Kinds and Quantities of Manure applied, the Yield of Potatoes, the Cost of Manure, and the Estimated Profit from the different applications, all calculated per Statute¹/₂ Acre.

DISTRICT.	NAME OF FARM.	NAME OF EXPERIMENTER.	NATURE AND CONDITION OF SOIL.	VARIETY OF POTATOES PLANTED.	1			2			3			4			5			6			7			8			9			10			11			12			13																																																																																																																																																																																																																																																																																																																																																																																																																																															
					No Manure.			20 tons Farmyard Manure.			10 tons Farmyard Manure.			10 tons Farmyard Manure, 1 cwt. Sulphate of Potash.			10 tons Farmyard Manure, 4 cwt. Super-phosphate.			10 tons Farmyard manure, 141 lbs. Nitrate of Soda.			10 tons Farmyard Manure, 1 cwt. Sulphate of Ammonia.			10 tons Farmyard Manure, 4 cwt. Super-phosphate, 1 cwt. Sulphate of Ammonia.			10 tons Farmyard manure, 4 cwt. Super-phosphate, 141 lbs. Nitrate of Soda.			10 tons Farmyard Manure, 1 cwt. Sulphate of Ammonia, 1 cwt. Sulphate of Potash.			10 tons Farmyard Manure, 141 lbs. Nitrate of Soda, 1 cwt. Sulphate of Potash.			10 tons Farmyard Manure, 4 cwt. Super-phosphate, 1 cwt. Sulphate of Ammonia, 1 cwt. Sulphate of Potash.			10 tons Farmyard Manure, 4 cwt. Super-phosphate, 141 lbs. Nitrate of Soda, 1 cwt. Sulphate of Potash.																																																																																																																																																																																																																																																																																																																																																																																																																																															
					Marketable	Small		Marketable	Small		Marketable	Small		Marketable	Small		Marketable	Small		Marketable	Small		Marketable	Small		Marketable	Small		Marketable	Small		Marketable	Small		Marketable	Small		Marketable	Small		Marketable	Small																																																																																																																																																																																																																																																																																																																																																																																																																																														
					Tons	Cwt	Qrs	Tons	Cwt	Qrs	Tons	Cwt	Qrs	Tons	Cwt	Qrs	Tons	Cwt	Qrs	Tons	Cwt	Qrs	Tons	Cwt	Qrs	Tons	Cwt	Qrs	Tons	Cwt	Qrs	Tons	Cwt	Qrs	Tons	Cwt	Qrs	Tons	Cwt	Qrs	Tons	Cwt	Qrs	Tons	Cwt	Qrs																																																																																																																																																																																																																																																																																																																																																																																																																																										
I.—Poulton.....	Oldfield Carr.....	Mr. W. Rossall.....	Loam.....	Reading Giant...	5	6	2	19	2		7	11	0	1	4	1	6	16	2	1	4	0	7	5	1	17	2	6	15	0	1	6	0	7	10	3	18	2	6	5	2	1	2	3	7	1	0	1	1	1	6	11	1	1	3	3	6	18	2	1	1	2	6	12	2	18	2	7	15	3	1	0	1	7	5	2	19	0		I.																																																																																																																																																																																																																																																																																																																																																																																																								
II.—Poulton	Town End.....	Mr. Walsh.....	Clayey	Kidneys.....	*6	2	1	*1	0	1	*7	16	0	*1	7	3	*7	7	2	*1	5	2	*7	15	1	*19	0	*7	2	1	*1	7	1	*7	17	3	*19	0	*6	19	3	*1	3	2	*7	10	0	*1	1	3	*7	2	1	*1	5	1	*7	6	2	*1	3	1	*7	4	3	*17	3	*8	5	0	*1	2	2	*7	16	3	*1	1	2		II.																																																																																																																																																																																																																																																																																																																																																																																																							
III.—Hutton	Dungeon.....	Mr. Rawsthorne.....	Alluvial sandy loam.....	Up-to-Date	9	12	1	15	3		11	10	0	15	0		10	17	1	12	1		12	3	2	12	1	11	18	1	13	2	10	10	0	13	1	11	19	0	14	1	12	5	3	12	3	12	1	2	11	3	11	7	3	15	3	11	2	3	16	0	12	2	3	11	3	12	15	0	16	2		III.																																																																																																																																																																																																																																																																																																																																																																																																														
IV.—Garstang	Needless Farm ..	Mr. Porter.....	Black peaty loam.....	Reading Giant...	6	1	1	10	2		9	6	2	6	1		8	0	1	7	3		7	15	1	6	2	7	16	2	7	0	7	19	3	7	3	8	2	1	9	0	8	4	1	6	2	8	3	2	7	1	8	7	1	8	2	8	0	1	9	2	9	3	3	7	2	9	0	1	6	2		IV.																																																																																																																																																																																																																																																																																																																																																																																																														
V.—Garstang	Carr End	Mr. J. J. Stirzaker	Medium loam.....	Maincrop	3	0	0	9	0		8	13	0	10	1		7	1	2	7	0		8	17	3	6	0	8	12	2	8	2	6	3	3	5	1	7	2	2	6	2	7	9	2	6	0	7	9	2	7	0	6	15	2	8	2	7	3	2	11	1	8	12	0	10	3	7	10	2	10	3		V.																																																																																																																																																																																																																																																																																																																																																																																																														
VI.—Garstang	The Island.....	Messrs. J. & J. Shaw...	Peaty, very loose.....	Reading Giant...	5	3	2	1	10	3	8	5	2	2	5	0	10	7	0	1	16	0	10	19	0	1	13	1	11	11	0	1	3	1	10	10	0	18	2	11	10	2	1	3	2	11	12	0	1	5	1	10	19	0	17	3	10	12	2	1	1	0	11	5	0	1	0	3	8	19	2	1	2	1	11	12	2	1	4	3		VI.																																																																																																																																																																																																																																																																																																																																																																																																						
VII.—Warrington	Cinnamon Brow.	Mr. Mather	Sandy loam	Reading Giant...	3	8	2	10	3		9	18	3	18	1		7	8	0	19	3		8	11	0	15	0	8	10	1	8	2	8	5	0	10	3	9	11	3	9	3	8	0	1	18	3	8	12	0	6	1	7	0	1	1	2	2	6	15	2	6	0	7	1	1	1	0	7	12	3	9	3		VII.																																																																																																																																																																																																																																																																																																																																																																																																													
VIII.—Liverpool	Stonehouse	Mr. Webster.....	Medium loam	Up-to-Date							*11	2	3	*12	1				*11	2	3	*15	0	*10	3	2	*11	1	*9	1	2	*10	1	*10	6	1	*11	1	*8	14	0	*11	3	*9	9	3	*10	3	*10	5	3	*10	3	*11	9	3	*10	3	*10	13	3	*15	0	*10	3	0	*11	1		VIII.																																																																																																																																																																																																																																																																																																																																																																																																																		
IX.—Standish	The Limes	Mr. Lewis.	Medium loam.....	Maincrop	3	0	0	5	0		8	0	0	7	3		8	0	0	7	2		9	0	0	5	0	9	5	0	5	0	8	10	0	5	0	8	12	2	5	0	8	5	0	7	2	8	12	0	7	1	9	0	0	6	3	8	15	0	5	0	8	15	0	5	1	9	0	0	5	3		IX.																																																																																																																																																																																																																																																																																																																																																																																																														
X.—Newton-le-Willows.	Lowton.....	Mr. J. Bent	Medium loam	Maincrop	1	4	1	1	3	0	7	10	0	1	1	2	6	18	1	16	2		7	8	1	17	1	6	18	2	16	2	7	13	1	15	2	8	1	0	13	2	8	4	3	15	0	7	19	1	12	0	8	14	0	10	1	8	10	2	11	0	9	0	0	10	2	8	12	3	11	0		X.																																																																																																																																																																																																																																																																																																																																																																																																														
TOTAL OF EIGHT FARMS					36	16	1	6	4	1	70	14	3	7	8	1	65	8	3	6	10	3	72	0	0	5	12	3	71	7	0	5	8	1	67	2	2	4	14	2	71	5	0	5	4	1	71	2	2	5	13	0	70	8	0	4	13	0	68	15	3	5	14	3	68	5	0	4	18	0	71	10	0	5	9	1	73	9	1	5	4	0																																																																																																																																																																																																																																																																																																																																																																																																						
Average of Eight Farms					4	12	0	15	2		8	16	3	18	2		8	3	2	16	1		9	0	0	14	0	8	18	1	13	2		8	7	3	11	3		8	18	0	13	0		8	17	3	14	0		8	16	0	11	2		8	12	0	14	1		8	10	2	12	1		8	18	3	13	3		9	3	3	13	0																																																																																																																																																																																																																																																																																																																																																																																																								
Total (Marketable and Small)					T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.	T.	C.	Q.

EXPERIMENT ON THE MANURING OF
SWEDES.

This experiment was conducted on somewhat similar lines to that on the Manuring of Meadow Hay, viz., certain Artificial Manures, used to a small extent in Lancashire, were tested alone, and on an adjoining set of Plots, in conjunction with Farmyard Manure. In the accompanying table will be found the names of the experimenters, the kinds and quantities of manures applied, and the weight off the Plots at each Farm, together with the cost of the manures, and the estimated profit or loss from the applications.

COMPARISON OF RESULTS.

I.—*Equal amounts of Phosphoric Acid from Super, Bone Flour, and Basic Slag (Plots 2, 3, and 4).*

The following are the figures from these three Plots :—

	Average Increase of Crop per Acre over Plots receiving no Artificials.					
	Without Dung.			With Dung.		
	T.	C.	Q.	T.	C.	Q.
5 cwts. Super	8	17	3	2	19	3
310 lbs. Bone Flour.....	7	6	2	2	19	1
400 lbs. Basic Slag	8	3	2	2	13	0

Without and with Farmyard Manure these Artificials have left a profit, but when used with Farmyard Manure the effect is very much less than when used alone. So far as the Phosphates from these three sources are concerned, the Superphosphate has yielded the best result in the series without Farmyard Manure. When used in conjunction with Farmyard Manure the average crop has been increased nearly three tons per acre by each of the manures, and no one shows to any great advantage over the other two.

II.—*Superphosphate alone, in conjunction with Nitrate of Soda, and in conjunction with Nitrate of Soda and Muriate of Potash (Plots 2, 5, and 7).*

The following are the figures :—

Without Farmyard Manure the complete mixture containing Phosphate, Nitrogen, and Potash has yielded, as might have been expected, a large and profitable increase. It would appear that the application of Nitrogen along with Phosphate for the Swede Crop is of less importance than the use of Potash. The use of Potash with Farmyard Manure has not yielded the same result.

The following are the figures :—

	Average Increase of Crop per Acre over Plots receiving no Artificials.					
	Without Dung.			With Dung.		
	T.	C.	Q.	T.	C.	Q.
5 cwts. Super.....	9	17	1	4	10	0
1 cwt. Nitrate of Soda.....						
5 cwts. Super.....	9	3	3	4	16	0
88 lbs. Sulphate of Ammonia.....						
5 cwts. Super.....	12	17	0	4	3	3
1 cwt. Nitrate of Soda.....						
1 cwt. Muriate of Potash						
5 cwts. Super.....	13	6	3	6	2	1
88 lbs. Sulphate of Ammonia.....						
1 cwt. Muriate of Potash						

On comparing the effects of Nitrate of Soda and Sulphate of Ammonia on these Plots the differences are not sufficient to warrant any conclusion that the one manure is much superior to the other for the purposes for which they were applied, and the soils on which they were used. On the whole, Sulphate of Ammonia has yielded the better result.

IV.—*The effects of 5, 7, and 9 cwts. respectively of a general mixture (Plots 9, 10 and 11).*

It is not an uncommon practice to employ as a manure for turnips, a mixture of various Phosphates, both soluble and insoluble, together with a small proportion of Sulphate of Ammonia and Kainit. The following mixture of this nature was compounded, viz. :—

- 2 parts Superphosphate
- 2 parts Pure Dissolved Bone
- 2 parts Bone Flour
- 2 parts Bone Meal
- 1 part Muriate of Potash
- 1 part Sulphate of Ammonia

Such a mixture supplies more than is required for growing the Turnip Crop. It is maintained by some that the principle of having more than is required is a safe one for the Swede Crop, and, since the largest proportion of the mixture is composed of materials that will not wash out of the land, it is believed that what is not required for the root crop is available for the succeeding grain or grass crop. The following are the figures from the Plots in question :—

	Average Increase of Crop per Acre over Plots receiving no Artificials.					
	Without Dung.			With Dung.		
	T.	C.	Q.	T.	C.	Q.
5 cwts. Mixture	10	8	3	2	12	1
7 cwts. „	12	11	3	4	15	3
9 cwts. „	11	8	2	3	4	3

Both on the dunged and undunged areas the medium dressing has yielded the largest crop. It is evident that the additional 2 cwts. applied to Plot 11, either alone or in combination with Farmyard Manure, has resulted in no benefit to the Turnip Crop, indeed there is evidence that such a large quantity has had an injurious effect.

The use of a general mixture, of soluble and insoluble Phosphates such as used on these Plots, cannot be recommended in view of the fact that Plots 7 and 8, to which only a soluble Phosphate was applied, have yielded even larger crops and at a much smaller cost.

V.—*The use of Artificials along with Farmyard Manure (Plots 1a compared with Plots 2a to 11a inclusive).*

The addition of Artificials as applied to the different Plots has yielded in every case an increase of crop, though only in certain cases has the cost of the manures been met by the value of the increase in the crop due to their application. In using Artificials along with Farmyard Manure, much greater skill is required in order to secure a profitable return than when the problem is the application of Artificials without Farmyard Manure.

SUMMARY OF RESULTS.

1.—Artificial Manures may be successfully employed for the growth of even larger root crops than those produced by the application of 12 tons Farmyard Manure alone.

2.—The application of Artificials along with Farmyard Manure is attended with small returns when compared with those obtained from the use of the same kinds and quantities of Artificials used alone.

3.—A comparison of equal amounts of Phosphoric Acid from Superphosphate, Bone Flour, and Basic Slag, shows a slight advantage in favour of Superphosphate when used alone, but in conjunction with Farmyard Manure they each yield on an average a similar increase.

4.—Artificial Manures for the growth of Swedes without Farmyard Manure should contain, in addition to considerable quantities of Phosphate, a certain percentage of Nitrogen and Potash. The application of Potash and Nitrogen along with Farmyard Manure is not necessary. Equal amounts of Nitrogen from Sulphate of Ammonia and Nitrate of Soda have yielded a marked increase on the undunged land, and there is no strong indication that the one is superior to the other. Seven cwts. of a mixture, containing equal parts of Super, Pure Dissolved Bone, Bone Flour, Bone Meal, and half part of Sulphate of Ammonia and half part of Muriate of Potash has yielded better and more profitable results than either 5 or 9 cwts. of the same mixture. The medium dressing yielded the largest crop, whether the manures were tested alone or in conjunction with dung.

5.—The use of a mixture of 5 cwts. Superphosphate, 1 cwt. Nitrate of Soda (or its equivalent of Sulphate of Ammonia), and 1 cwt. Muriate of Potash has yielded not only the largest, but the most profitable returns.

Experiments on the Manuring of Swedes, 1898.

TABLE shewing the kinds and quantities of Manure applied, together with the weight of Dressed Roots, the value of the increase due to Artificial Manures, the cost of the Manures, and the Profit or Loss from the different applications, all calculated per Statute Acre.

DISTRICT.	NAME OF FARM.	NAME OF EXPERIMENTER.	CHARACTER OF SOIL.	VARIETY OF TURNIP.	WITHOUT FARMYARD MANURE.											WITH AN EVEN DRESSING OF 12 TONS OF FARMYARD MANURE PER ACRE.											
					1	2	3	4	5	6	7	8	9	10	11	1a	2a	3a	4a	5a	6a	7a	8a	9a	10a	11a	
					No Artificial Manure.	Super-phosphate 5 cwt.	*Bone Flour 310 lbs.	*Basic Slag 400 lbs.	Super-phosphate 5 cwt., Nitrate of Soda 1 cwt.	Super-phosphate 5 cwt., Sulphate of Ammonia 88 lbs.	Super-phosphate 5 cwt., Nitrate of Soda 1 cwt., Muriate of Potash 1 cwt.	Super-phosphate 5 cwt., Sulphate of Ammonia 88 lbs., Muriate of Potash 1 cwt.	General Mixture § 5 cwt.	General Mixture § 7 cwt.	General Mixture § 9 cwt.	Farmyard Manure 12 tons.	Super-phosphate 5 cwt.	Bone Flour 310 lbs.	Basic Slag 400 lbs.	Super-phosphate 5 cwt., Nitrate of Soda 1 cwt.	Super-phosphate 5 cwt., Sulphate of Ammonia 88 lbs.	Super-phosphate 5 cwt., Nitrate of Soda 1 cwt., Muriate of Potash 1 cwt.	Super-phosphates 5 cwt., Sulphate of Ammonia 88 lbs., Muriate of Potash 1 cwt.	General Mixture § 5 cwt.	General Mixture § 7 cwt.	General Mixture § 9 cwt.	
I.—Garstang	Ford Green.....	Mr. Melling	Peaty	Taits' Best of All.....	tons cwt. qrs 6 0 0	tons cwt. qrs	tons cwt. qrs 10 0 0	tons cwt. qrs 15 10 0	tons cwt. qrs 16 10 0	tons cwt. qrs 13 0 0	tons cwt. qrs 23 10 0	tons cwt. qrs 22 0 0	tons cwt. qrs 20 10 0	tons cwt. qrs 23 10 0	tons cwt. qrs 22 0 0	tons cwt. qrs 16 0 0	tons cwt. qrs 19 10 0	tons cwt. qrs 18 10 0	tons cwt. qrs 21 10 0	tons cwt. qrs 23 10 0	tons cwt. qrs 23 10 0	tons cwt. qrs 24 0 0	tons cwt. qrs 25 10 0	tons cwt. qrs 23 0 0	tons cwt. qrs 24 10 0	tons cwt. qrs 24 0 0	I.
II.—Garstang	Carr End.....	Mr. J. J. Stirzaker	Medium Loam	Halewood	13 11 1	22 15 1	21 14 0	24 10 1	24 18 1	24 0 3	25 11 0	26 18 2	23 14 3	22 8 0	23 12 3	21 18 3	23 15 2	25 7 0	21 18 3	25 16 1	24 10 3	22 14 3	27 5 0	21 8 2	20 19 1	21 5 1	II.
III.—Poulton	Town End	Mr. T. Walsh	Clay	Webbs' Imperial	22 0 0	18 19 3	18 3 2	18 0 0	20 3 1	20 2 2	19 0 0	23 7 1	22 0 0	24 9 0	24 0 0	20 0 0	22 0 0	24 0 0	20 1 2	22 0 1	23 2 0	24 0 0	25 1 0	24 0 0	22 14 1	10 1 3	III.
IV.—Poulton	Norcross	Mr. Nelson	Clay	{ Kennedy's Prize Taker, Dickson's Defiance .....	....	....	....	....	....	....	....	....	....	....	....	19 10 0	20 5 0	21 8 2	20 0 2	18 3 3	18 9 3	18 12 2	24 0 0	26 5 0	20 15 2	24 0 0	IV.
V.—Standish	Wakefield	Mr. Dobson.....	Medium	Turton's Green Top.....	3 5 3	16 10 3	16 11 3	14 7 1	17 0 0	14 12 0	19 8 1	18 5 0	18 8 1	18 6 0	18 8 1	15 10 0	19 0 0	18 4 0	18 4 3	18 3 0	17 8 0	19 11 2	18 17 3	19 2 3	18 15 0	18 0 0	V.
VI.—Hawkshead ...	Esthwaite Hall	Mr. Rushforth	Sharp, gravelly	Halewood.....	13 14 1	17 7 1	18 1 0	18 2 1	19 13 1	22 15 1	22 14 1	25 5 3	20 13 2	23 8 1	20 11 2	....	20 16 3	19 5 3	20 7 2	21 0 0	23 9 3	22 2 2	22 12 1	18 11 3	23 4 0	20 10 1	VI.
VII.—Carke	Holker Hall	Mr. Victor Cavendish, M.P.	Sand	Sutton's Champion	11 7 1	17 5 0	15 15 0	15 6 2	19 3 2	19 10 0	21 0 0	22 3 2	16 16 2	23 5 0	20 9 1	21 12 3	24 15 0	24 17 1	24 0 0	25 12 1	28 16 2	25 10 0	27 17 1	21 19 1	30 0 0	24 15 0	VII.
TOTAL.....					47 18 2	75 18 1	82 1 3	87 16 1	97 5 0	93 18 0	112 3 2	114 12 3	100 3 0	110 17 1	105 1 3	75 1 2	87 0 2	86 18 1	85 13 2	93 1 2	94 5 1	91 16 1	99 10 0	85 10 2	94 4 1	88 0 1	
Average.....					9 11 3	18 9 2	16 18 1	17 15 1	19 9 0	18 15 2	22 8 3	22 18 2	20 0 2	22 3 2	21 0 1	18 15 1	21 15 0	21 14 2	21 8 1	22 5 1	23 11 1	22 19 0	24 17 2	21 7 2	23 11 0	22 0 0	
Increase over Unmanured Plots 1 and 1a respectively .....					....	8 17 3	7 6 2	8 3 2	9 17 1	9 3 3	12 17 0	13 6 3	10 8 3	12 11 3	11 8 2	....	2 19 3	2 19 1	2 13 0	4 10 0	4 16 0	4 3 3	6 2 1	2 12 1	4 15 3	3 4 3	
Value of Increase, at 10s. per ton.....					....	£ s. d. 4 8 10	£ s. d. 3 13 3	£ s. d. 4 1 9	£ s. d. 4 18 7	£ s. d. 4 11 10	£ s. d. 6 8 6	£ s. d. 6 13 4	£ s. d. 5 4 4	£ s. d. 6 5 10	£ s. d. 5 14 3	....	£ s. d. 1 9 10	£ s. d. 1 9 7	£ s. d. 1 6 6	£ s. d. 2 5 0	£ s. d. 2 8 0	£ s. d. 2 1 10	£ s. d. 3 1 1	£ s. d. 1 6 1	£ s. d. 2 7 10	£ s. d. 1 12 4	
Cost of Artificial Manure per acre .....					....	12 6	8 8	7 1	1 1 9	1 1 8	1 13 3	1 13 2	1 7 0	1 17 10	2 8 8	....	12 6	8 8	7 1	1 1 9	1 1 8	1 13 3	1 13 2	1 7 0	1 17 10	2 8 8	
Estimated Profit per acre .....					....	3 16 4	3 4 7	3 14 8	3 16 10	3 10 2	4 15 3	5 0 2	3 17 4	4 8 0	3 5 7	....	17 4	1 0 11	19 5	1 3 3	1 6 4	8 7	1 7 11	† 11	10 0	†16 4	

* Containing the same amount of Phosphoric Acid as that applied in 5 cwt. Superphosphate (Plot 2).
† Containing the same amount of Nitrogen as that applied in 1 cwt. Nitrate of Soda (Plots 5, 7, 5a, and 7a).
‡ Loss.
§ Compound of two parts of each of the following:—Superphosphate, Pure Dissolved Bones, Bone Flour, Bone Meal, with one part of Sulphate of Potash and one part of Sulphate of Ammonia.
¶ The lines not included in average.

COMPARISON OF CROP YIELDED BY SEVEN VARIETIES OF POTATOES, AND THE EFFECT OF SPRAYING AS A PREVENTIVE OF POTATO DISEASE.

These trials were made at the County Council Farm. The soil was a blackish loam. The previous crop was Ryegrass Hay, and the Manure applied consisted of a medium dressing of Farmyard Manure in the row, together with 8 cwts. Superphosphate, 2 cwts. Sulphate of Ammonia, and 2 cwts. Sulphate of Potash. The land was regular. Spraying was done on the 23rd August, when the disease began to appear. The material used was a 2 per cent. solution of Mc.Kenzieite, and it was applied with a knapsack sprayer. The cost of the machine was 35s., and of Mc.Kenzieite 6s. 8d. per acre. Such a sprayer is too small for large fields, for which a horse machine can now be obtained.

RESULTS.

1.—The Up-to-Date variety yielded the largest crop, and a very high increase over most other varieties. The percentage of diseased tubers was small in this variety.

2.—Cole's Favourite produced a good crop, but the percentage of diseased was very high compared with the other varieties.

3.—Where the disease was serious spraying with Mc.Kenzieite reduced the percentage of diseased tubers from 39 to 24.

4.—The total weight of crop has not been improved by spraying.

TABLE SHOWING THE VARIETY OF POTATOES PLANTED, AND THE YIELD OF SOUND AND DISEASED TUBERS, ON SPRAYED AND UNSPRAYED PORTIONS, ALL CALCULATED PER STATUTE ACRE.

Variety.	Not Sprayed.				Sprayed Aug. 23, with Mc.Kenzieite.										
	Total Sound per Acre.			Diseased per Acre.	Total Sound per Acre.		Diseased per Acre.	Per cent. Diseased.	Decrease of crop per acre on Sprayed portion.						
	T.	C.	Q.	C.	Q.	T.	C.	Q.							
Coles' Favourite	7	11	1	96	3	39.0	8	13	3	55	3	24.3	0	18	2
Up-to-Date	12	5	3	18	2	7.0	11	17	1	5	2	2.3	1	1	2
Sutton's Abundance ...	9	18	1	12	1	5.8	9	18	3	9	2	4.6	0	2	1
Bruce.....	10	7	0	4	1	2.0	9	0	3	4	1	2.3	1	6	1
Beauty of Bute.....	6	12	1	9	2	6.7	6	3	3	4	1	3.3	0	13	3
Maincrop	8	10	0	6	1	3.5	8	10	2	7	0	4.0	*0	1	1
Wonder	7	10	0	6	1	4.0	6	17	3	4	1	3.0	0	14	1

* Increase.

LIME AS A CAUSE OF SCAB IN POTATOES.

The Potato crop in the Warrington neighbourhood is often very badly affected by scab—an eruption on the skin of the tuber. In the discussion at the close of my lectures given in that neighbourhood, it was repeatedly asserted that lime is one, if not the chief, cause of scab. The following experiment was made at the County Council Farm to test the accuracy of this statement:—

To Plots of half square pole in extent quick lime was applied at the rate of 5, 7, 9, 11, and 13 tons per acre. As in the opinion of some, lime in a “slutched,” *i.e.*, pasty condition, is more likely to cause scab than if applied in the powdered form, one plot was dressed, at the rate of five tons per acre, with lime which was allowed to lie unspread until it had become pasty. On the other Plots the lime was spread when in the powdery condition. Lime from compost heaps was likewise accused of causing scab; lime in this form was therefore added to another Plot. The manure applied was a moderate dressing of dung, and the variety of Potato planted was that known as Colossal.

The plan of the experiment was as follows:—

	Date of Application.
Plot 1.—No lime.	
„ 2.—5 tons lime, “slutched”	... February 16th.
„ 3.—5 tons lime, in powder	... „
„ 4.—7 „ „	... „
„ 5.—9 „ „	... „
„ 6.—11 „ „	... „
„ 7.—13 „ „	... „
„ 8.—5 tons compost lime...	... April 1.

RESULT.

Not the slightest appearance of scab on any of the Plots. This result will not be accepted as final by the farmers on whose behalf the trial was made. Their criticism will be that—

1.—It is not so much in the first as in the second and subsequent years after application that lime causes scab. To meet this the same Plots should be again planted with Potatoes.

2.—Some varieties of Potatoes are more readily affected by scab than others. To meet this objection the Plots should be planted next year with two or more varieties of Potatoes which are supposed to be specially subject to scab.

3.—The soil at the County Council Farm—a blackish loam—is different from the soil in the Warrington neighbourhood, where scab is prevalent. To meet the objection on this point the experiments should be carried out in duplicate, on a field selected by the farmers themselves.

FINGER AND TOE EXPERIMENTS.

This disease is of frequent occurrence in the North of Lancashire, where the soil is more freely cultivated and put under root crop than in most other parts of the County.

Finger and Toe, as is now well known, is a disease that prevails where the land comes too often under root crop, or more precisely, where crops belonging to the order *Cruciferae* (as for example, Swedes, Turnips, Rape, Cabbage, and Mustard), are taken too frequently.

A perfect cure is to let the field lie in grass for four or five years. When this course is not expedient the next best preventive is a dressing of lime (three to five tons per acre) applied one year previous to that in which the root crop is to be taken.

One of the objects of the present experiment was to demonstrate the importance of an early application of lime when that is used for the express purpose of checking this disease.

The following experiment was conducted by Mr. Hall, The Farm, Cark-in-Cartmel.

CARK EXPERIMENTS.

The field at Cark had grown Rape the previous season, and the Rape crop was completely infested with the disease. Mr. Hall kindly offered $\frac{3}{4}$ of an acre of this land for experimental purposes. The $\frac{3}{4}$ acre was accordingly divided into six plots of $\frac{1}{8}$ acre each, and these were treated in the following manner. The land was ploughed in December, Plot A receiving at that time a dressing, at the rate of 10 cwts. per acre, of crude potash, a substance obtained from iron works. This material contained about 26 per cent. Potash, and was extremely caustic. The object in applying crude potash was to test whether lime prevents Finger and Toe on account of its caustic properties. It is well known that an acid condition of soil (whether brought about by a too liberal use of dissolved manures, or by wetness) is one which is very favourable to the propagation of the disease. Lime destroys acid, so does the crude potash applied to Plot A; accordingly Plot B was dressed on December 8th with quick lime at the rate of four tons per acre, for comparison with Plot A. In the field where the experiment was conducted, Mr. Hall had an old compost heap, composed of weeds and lime. The compost was in a condition ready to be applied to the land. With this, Plot C was dressed in December at the rate of 24 loads per acre. A similar quantity from the same heap was applied to Plot D, but not until spring, when it was put into the rows along with the manure. The field lay at no great distance from the sea shore, where there is a large amount of sand, of which a quantity equal to 24 loads per acre

FINGER AND TOE EXPERIMENTS AT CARK.

Each Heap represents the Crop off 1/8th acre.



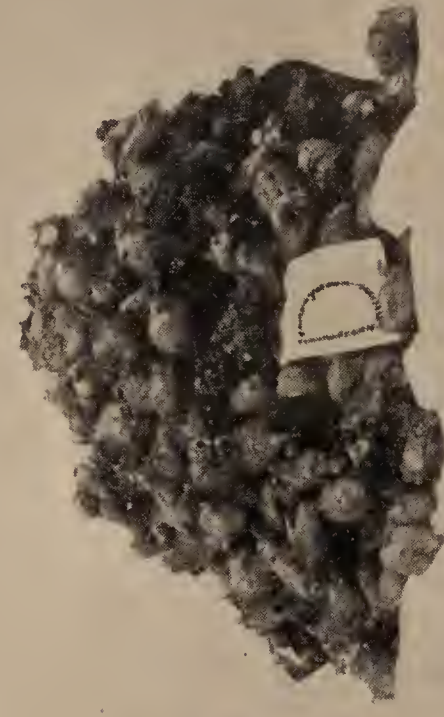
10 cwts. Crude Potash
per acre, applied in
December.



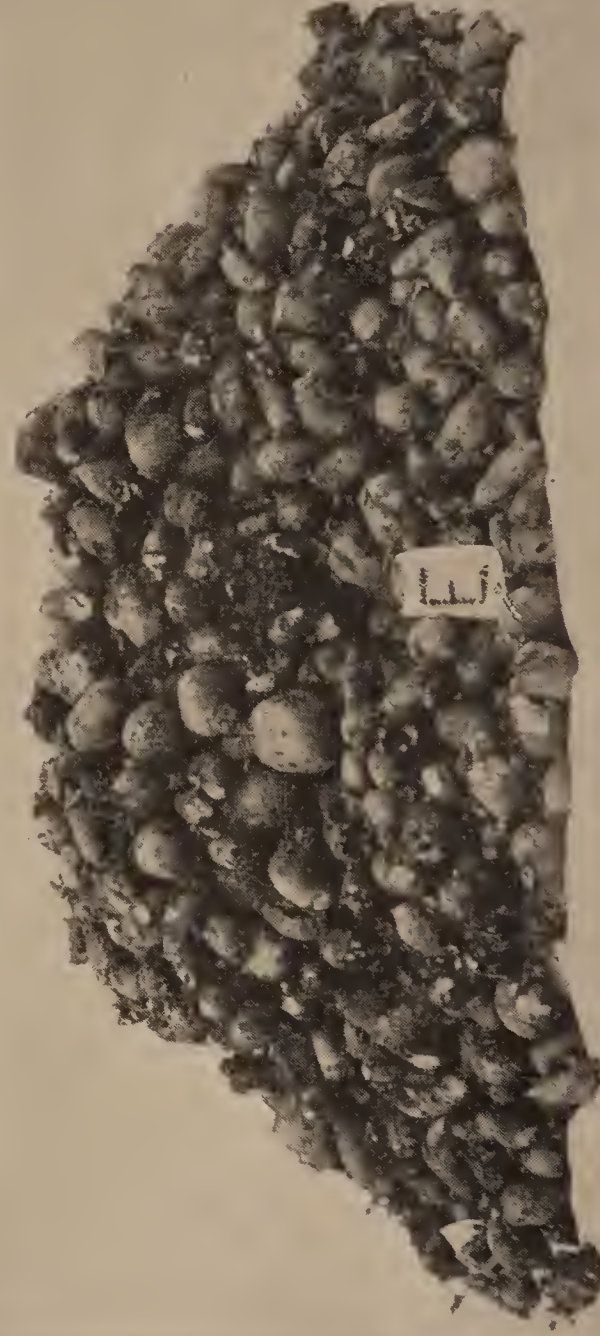
4 tons Lime per acre, applied
in December.



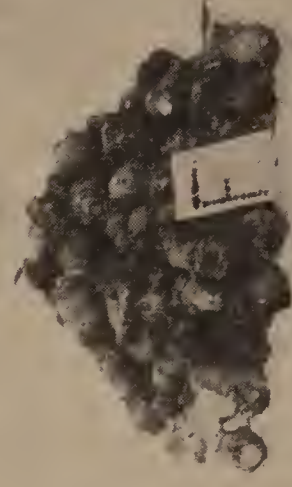
Compost in December.



Compost in Spring.



24 loads Sand per acre, applied
in December.



No treatment, but
received same fertilizer
as other Plots.

was applied to Plot E along with the manure in the drill. The sixth and last Plot, viz. : Plot F, received only such Artificial Manures as were applied equally to every Plot; no Farmyard Manure was applied to any of the Plots. The Artificial Manure consisted of a mixture of equal parts of Superphosphate, Pure Dissolved Bone, Bone Flour, Bone Meal, Kainit, and $\frac{1}{2}$ -part of Sulphate of Ammonia. The field was sown with Swedes, and in autumn the whole crop off each Plot, that is, off $\frac{1}{8}$ of an acre, was collected into a heap and photographed. The results are reproduced on the opposite page.

OBSERVATIONS ON THE RESULTS.

That the land was thoroughly saturated with disease is evident from heap F, which represents all the crop off $\frac{1}{8}$ of an acre; not a single root has escaped disease. The illustration represents merely a few isolated decaying stumps—all that remained of the crop on this Plot in autumn.

The application of 10 cwts. of crude potash (Heap A) has had no effect. It is perhaps scarcely correct to conclude from this that the beneficial results of lime in checking the disease is *not* due to its power of neutralising acid, but undoubtedly the result points to that conclusion. Ten cwts. crude potash per acre. is capable of neutralising a very large amount of acid, yet it affected no improvement.

Lack of potash in the soil has been assigned as one cause of Finger and Toe. In this experiment a substance containing about 26 per cent. of potash, and applied at the rate of 10 cwts. per acre, has failed to check the disease in the least degree, a result which shows clearly that the application of potash may have no effect whatever in preventing the disease. A duplicate test at Hutton with crude potash yielded exactly similar results.

A comparison of Heap C (compost in December) with Heap D (compost in spring) emphasises very decidedly the importance of applying lime early when it is used to prevent Finger and Toe. Heap C is by no means a good crop, nor is it free from disease, but it must be remembered that there are few fields which are so thoroughly saturated with disease as the one on which the experiment was made. The use of old compost lime has influenced the crop in a remarkable manner, but only when applied early. The spring application (Heap D) has produced a crop very much inferior both in quantity and freedom from disease compared with the crop from the land treated in December. The cause of this is, of course, the fact that lime applied in spring does not thoroughly permeate and come into close contact with the particles of the soil. Lime, even when applied in autumn as a preventive of disease, is not altogether satisfactory. A most excellent method of using lime for this purpose is to apply it to the seeds or ley before ploughing the same for a corn crop, and when the stubble comes to be turned over, the plough

should go one or two inches below the lime and lift it to the surface. In this way the lime is well mixed with the soil, and produces its maximum effect in checking this disease.

The application of four tons of quick lime per acre in December has given a result inferior to that from the land dressed with 24 loads of the compost at the same period. We have, however, no means now of determining the actual amount of lime in the compost heap, and are, therefore, unable to institute a comparison between the four tons of lime applied to Plot B, and the amount of lime in the 24 loads of compost applied to Plot C. Mr. Hall estimated roughly that there would be about four tons of lime in the 24 loads of compost. At any rate, the application of the old compost has yielded a much better result than the application of quick lime.*

Plot E has yielded a result quite surprising. The heap of roots is quite as large and as free from disease as is that yielded by the old compost applied early. The sand applied to this Plot was analysed, and yielded the following results:—

Potash	...	...	...	·12 per cent.
Phosphoric Acid	...	...	...	·08 „
Lime	...	...	...	4·56 „

Whether the lime is the cause of the excellent result or not is a question that cannot be answered positively, but that it partially accounts for it is more than probable.

THE EXPERIMENTS AT THE COUNTY COUNCIL FARM.

These plots were on a much smaller scale than those at Cark. The land, except Plot 1, was specially inoculated with diseased roots which had been pulped and allowed to decay among soil during the Winter. When the plants were thinned an equal number was left on each plot. The accompanying illustration shows the resulting crop off equal areas of land, the treatment being as follows:—

Plot 1. Not specially inoculated with disease.

Plots 2, 3, 4, 5, 6, and 7. Specially and equally inoculated with disease.

Plot 1 received dung equal to 10 tons per acre alone.

„ 2	„	„	„	„	with 8 cwts. Super-phosphate.
„ 3	„	„	„	„	with 8 cwts. Basic Slag.
„ 4	„	„	„	„	with 3 tons Compost, late application.
„ 5	„	„	„	„	with 3 tons Compost, early application.
„ 6	„	„	„	„	with 3 tons Quicklime, late application.
„ 7	„	„	„	„	with 3 tons Quicklime, early application.

* Unfortunately the Photographer has not succeeded in producing Heaps A & B on the same scale as the remaining heaps.

FINGER AND TOE EXPERIMENTS

AT THE COUNTY COUNCIL FARM.



1



2

3



4



5



6



7

THE NUMBERS CORRESPOND WITH THOSE OF THE PLOTS.

Results.

1.—The inoculation of the land with diseased roots yielded crops badly infested with disease. The importance of taking steps to prevent diseased roots getting into the manure heap and eventually on to land intended for root crops is here clearly demonstrated.

2.—The crop manured with 8 cwts. Superphosphate was completely destroyed; where Basic Slag, at the rate of 8 cwts. per acre, was applied, the result was scarcely better.

3.—The application of lime exerted a strong influence in preventing disease. In this respect Quicklime acted more powerfully than Compost. (On this point the Cark and Hutton Experiments do not agree.)

4.—The early application of lime, both quick and in the form of Compost, was much more effective than the same kinds and quantities of lime applied in Spring.

OTHER EXPERIMENTS ON FINGER AND TOE AT THE COUNTY COUNCIL FARM.

Alternating Swedes and Turnips as a preventive of Finger and Toe.

It has been suggested that if Swedes be grown where yellow or white Turnips grew when the field was last in roots, and *vice versa*, the disease might in consequence be less severe. This suggestion was tried at the Farm, Swedes being sown on land inoculated with disease from Swedes and also with disease from Yellow Turnips. The converse was also tried, viz.: Yellow Turnips were sown on land infected with disease taken from Swedes, and also on land infected with disease taken from Yellow Turnips. As those who best understand Finger and Toe will expect, the crop was in all cases equally affected, the suggestion which prompted the trial being apparently worthless.

The Achilles Turnip compared with two other varieties.

The Achilles Turnip, which I have repeatedly shown resists disease more powerfully than any other variety, was sown on infected soil along with Fosterton-Hybrid, and a third variety, said to be the original of the Achilles. Results:—

1.—A full crop of Achilles, scarcely affected by disease.

2.—Half a crop of Fosterton-Hybrid, badly affected by disease.

3.—A three-quarter crop of the so-called original Achilles, about half destroyed with disease, the remaining sound roots bearing a strong resemblance to the Achilles turnip.

TEST OF VARIETIES OF SWEDES.

One acre at the County Council Farm was sown with 20 varieties of Swedes on the 14th of May. The weights are those of the roots from $\frac{1}{120}$ of an acre. This area, though small, made it possible to secure uniformity of soil for each variety. The manure used was the same for each, and consisted of a moderate dressing of Farmyard Manure together with 10 cwts. per acre of a mixture composed of:—

Two parts Slag
 Two parts Pure Dissolved Bones
 Two parts Bone Meal
 Two parts Bone Flour
 One part Muriate of Potash
 One part Sulphate of Ammonia

The accompanying table shows the names of varieties grown and the yield of each per $\frac{1}{120}$ acre.

RESULTS.

These varieties might easily be reduced to a few types, there being very little difference between some of them. Drummond's Bronze Top is equalled in weight by one other variety, viz., Dickson's Emperor. The crop of Bronze Top Swedes was one of the soundest. In 1896, I made a trial with a still larger number of varieties of Swedes. Drummond's Bronze Top was then, as now, at the head of the list

VARIETIES OF SWEDES

Name of Swede.	Weight of Roots per $\frac{1}{120}$ Acre.			
	Sound.			Diseased.
	cwts.	qrs.	lbs.	lbs.
1.—Webb's Imperial.....	4	3	3	12
2.—Webb's Giant King	4	3	20	8
3.—Sutton's Champion	4	1	23	7
4.—Sutton's Crimson King	4	3	6	16
5.—Dickson's Emperor.....	5	1	7	12
6.—Kennedy's Monarch	5	0	5	14
7.—Hunter's Monarch	5	1	2	6
8.—Drummond's Monarch	4	1	6	16
9.—Carter's Elephant	4	1	14	12
10.—Carter's Kangaroo	4	3	27	6
11.—Drummond's Stirling Castle ...	4	1	6	2
12.—Drummond's Improved.....	4	0	26	12
13.—Kennedy's Prize-taker	4	0	26	11
14.—Dickson's Defiance.....	4	3	26	10
15.—Tait's Best of All	4	3	12	14
16.—Sutton's Magnum Bonum	4	3	10	4
17.—Sutton's Queen	4	1	23	5
18.—Drummond's Bronze Top	5	1	7	1
19.—Webb's Arctic	4	2	15	2
20.—Dickson's Lord Derby	4	2	17	10

ON SPRAYING CHARLOCK WITH A SOLUTION OF SULPHATE OF IRON.

In the *Yorkshire Post* for April 30th, 1898, there appeared the following introduction to an article by Professor Jas. Long :—

“ WEED DESTRUCTION ON THE FARM : A DISCOVERY IMPORTANT TO FARMERS.

“ A year ago we referred to some experiments which had been conducted in France, in one of the chief wine districts, in connection with the destruction of wild mustard or charlock and other cruciferous plants of the same detestable character when growing in corn crops. The occupier of a vineyard had been making some tests in the spraying of his vines when he noticed that the spray which had fallen upon charlock had destroyed them. Forthwith an experiment was made upon a crop of oats in which charlock was growing with great freedom. The oats were practically undamaged while the charlock was destroyed. The discovery caused considerable interest to be evoked on the Continent, with the result that many experiments of a more carefully arranged character were carried out both in France and Germany.”

At the time this appeared there was no charlock growing at the County Council Farm, nor was there any in the immediate neighbourhood. Nevertheless, it was decided to test the discovery on behalf of Lancashire farmers who might be troubled with the pest, and a sprayer was despatched to Walter Ovens, Esq., of Torr, Auchencairn, Castle Douglas, on whose farm at that time there was a field very badly infested with charlock weed. The details of the experiment and its result may best be described by giving here Mr. Ovens's report to me.

“ SPRAYING CHARLOCK.

“ This experiment was carried out on two adjoining portions of a field of oats, after lea, in which charlock was growing most luxuriantly. One portion consisting of 110 square yards, was reserved for spraying, and the other for comparison with it, whilst the remainder of the field was, with the exception of a margin of four yards around the experimental plots, gone over with a charlock weeding machine.

“ The oats were fully 12 inches in length when, on the 14th June, a solution of Sulphate of Iron, diluted to 13 per cent., was applied with this sprayer.

“The result was the almost total destruction of the charlock; and after a few days, the contrast between the two plots was most marked, one being dark green, the other quite yellow, with charlock in full flower. The thistles in the sprayed plot got blackened and weakened, whilst the Oats were practically uninjured.

“The good effects of spraying were also very apparent at harvest time. When cutting the crop on the 25th August, there was no difficulty whatever in reaping the sprayed portion, whereas the binder was at every round pulled up shortly after entering the unsprayed plot, owing to the abundance of charlock.

“The two plots were equally ripe when cut.

“The quantity of Iron Sulphate applied in this experiment would be equal to rather less than 100lbs. per acre.

“The second experiment was carried out in an oat field sown down with Clovers and Ryegrass, to determine whether or not the Iron Sulphate had any injurious effects on the young Clovers.

“The charlock in this field was, in comparison with the other, thinly seeded, but a very equal portion of the field was selected.

“Three plots were fixed upon—the centre one to be left unsprayed.

“The Oats were about 14 inches in length, when in the beginning of July, one plot was sprayed with a 15 per cent. and the other with a 20 per cent. Solution. The result was that in both plots the charlock was quite exterminated, and the few thistles, especially in the 20 per cent. plot, were badly blackened and weakened, whilst in the unsprayed plot, the charlock had grown freely.

“The Solution did not appear to have any injurious effects either on the Oats or young seeds, and at harvest time, the Oats were as early and as well grown, and the Clovers as luxuriant, as on the unsprayed plot.

“The experiments conducted with a hand-worked machine have thus been a marked success, and if a large sprayer, drawn by a horse can be satisfactorily managed, another mode has now been discovered of getting rid of, at times, a great agricultural pest.”

One of these experiments, I myself superintended, and also witnessed the excellent results described in the above report. A photograph of one of the plots was taken, but its reproduction on

the opposite page conveys a very poor idea of the marked contrast presented a few days after the experiments by the sprayed and unsprayed portions of the field. The sprayed plots were quite green and free from weed, while the others were surrounded with a dense border of yellow flowers.

The strengths of the solution used, viz., 13, 15, and 20 per cent. are perhaps too strong to risk on a large area, though certainly there was no indication of the slightest harm to the oat crop in these experiments. It would, perhaps, be safer to make the experiment at first on a somewhat small scale, and to use a 10 per cent. solution.

During 1899 further experiments will be conducted by a number of educational bodies.

The small sprayer used in the experiment above described is quite useless for dealing with large areas, for which there is now being manufactured a sprayer drawn by horse. With this a large number of acres can be covered in one day.

Any farmer who is troubled with the charlock pest may be confidently recommended to try these machines, one of which can now be had at a fairly reasonable price.

ON THE USE OF "NITRAGIN" AND "ALINIT" FOR THE GROWTH OF BEANS AND OATS RESPECTIVELY.

As is now well known, Beans and Clover, in common with other leguminous plants, have on their roots nodules in which are to be found certain organisms which are instrumental in enabling the plant with which they are associated, to draw on the air for its supplies of nitrogen. Accordingly it is not necessary to apply a nitrogenous manure to a leguminous crop.

A few years ago a German firm prepared cultivations of the organisms found in the nodules of several species of leguminous plants, and these were sold to the farmers for application to land upon which the respective crops were to be grown, the object being to supply the soil with a sufficient number of the desired organisms. The preparation, which consisted of a growth of the specific bacterium on gelatine, is known as "Nitragin."

In the summer of 1897, Plots were laid out by Mr. Daine at the County Council Farm with the object of testing this preparation both on Beans and on Clover. At the end of the season I was able



*The letter A marks the centre of a Plot treated with Sulphate of Iron Solution.
The Plot is bordered by an unsprayed area, which shows the amount of weed on Plot A before it was sprayed*

to report that there appeared to be a small advantage from the use of Nitragin on both these crops. During 1898 the experiment was repeated at the County Council Farm with the two crops already mentioned. The result this year has not fulfilled the expectations held out by the results of 1897. There was no improvement from the use of Nitragin either on Beans or Clover.

Following the example of the manufacturers of Nitragin, the firm of Messrs. Friedr. Bayer, & Co., Elberfeld, last year introduced on the market a preparation under the name of "Alinit," which they described as the cheapest manure for all kinds of grain crops. The powder contains an organism which, either by its energetic action in decomposing organic matter, or in assimilating free nitrogen, is alleged to make the application of Nitrogenous Manures unnecessary.

The inventor of the system is a gentleman farmer in Germany, who affirms that, by the use of his system on his own land, he has obtained an increase of 40 per cent. of grain over uninoculated land.

The cost of Alinit is only a few shillings per acre. The powder must be added to water about 24 hours before use, and kept at room temperature. With this the seed—wheat, barley, oats, or rye—is sprinkled before being sown.

The preparation was tested at the County Council Farm, but without any apparent good result. Reports just to hand from Germany on the use of Alinit are contradictory.

